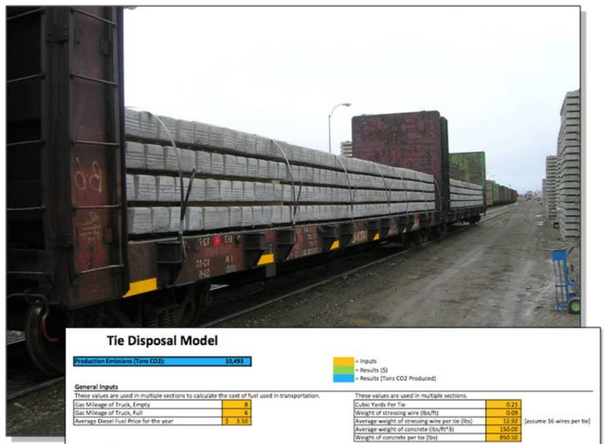
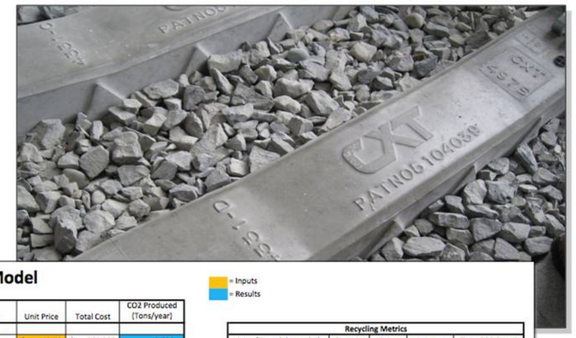
CN / CXT Sustainability Assessment

Transportation Enterprise

Michigan Tech — Create the Future





Project Scope:

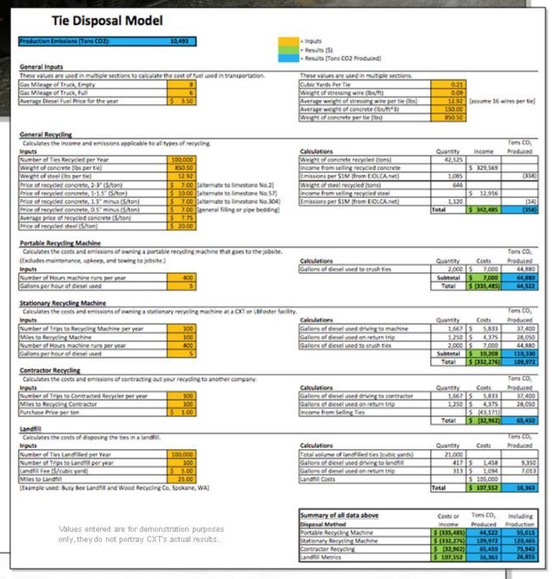
This project involved information collection and development of recommendations for the sustainable production of concrete ties. Research spanned sustainability, CXT company practices and supply chain, concrete tie production techniques, life cycle analyses, tie disposal through recycling and reuse, and process modeling. The main objectives of the project were to:

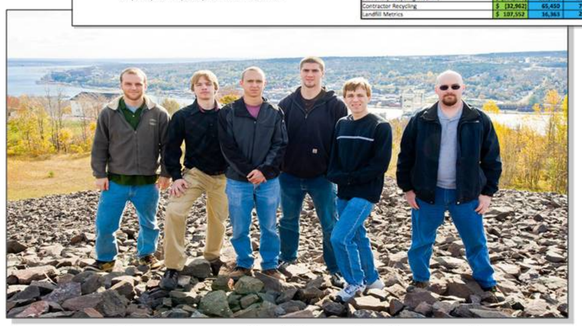
- Create a model that tracks the sustainability of CXT Concrete Ties
- Identify applicable and practical performance metrics that can serve as benchmarks
- Calculate the carbon footprint for Spokane, WA CXT production facility
- Compare the sustainability of concrete and wood ties
- Define what sustainability should be for CXT

Definition of Sustainability:

Sustainability is meeting current economic needs while promoting social qualities and environmental practice as much as possible from the extraction of materials before production to when the product is discarded after final use. For CXT this means the efficient allocation of material resources to create a quality product, while providing a safe workplace for employees and having an active presence in the community.

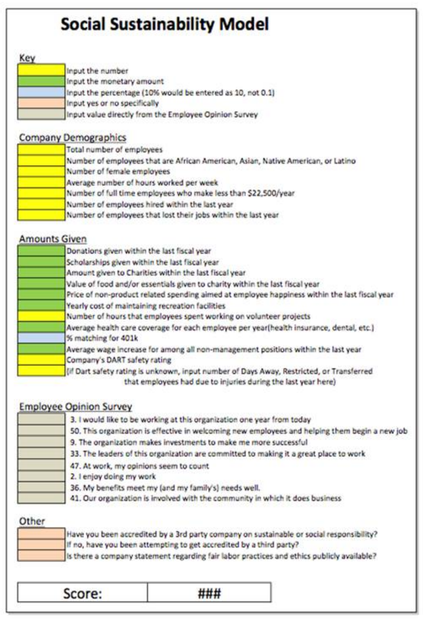
LBFoster
CXT Concrete Ties





Transportation Enterprise

- **Work with Industry Partners on Real Challenges**
- **Looking for Industry Sponsors and Project Ideas**
- **http://transportation.enterprise.mtu.edu**
- **Contact: George Dewey at gdewey@mtu.edu**



Project Results:

Through research and numerous meetings with industry sponsors, CN and CXT, and university professors, we were able to define sustainability in respect to CXT's manufacturing processes and develop models to track CXT's sustainability over time. Our final deliverables were:

- Model that tracks CXT's production emissions based on fuel consumption, as well as energy and material usage
- Model that evaluates CXT's social sustainability based on employee satisfaction, demographics, and safety, as well as benefits provided to employees and the community
- Model to evaluate various tie disposal options, both by emissions and potential profit
- Literature review comparing lifetime CO_2 emissions of concrete and wood ties
- Definition of sustainability as applied to CXT

Production Facility Model

= Inputs
= Results

Material	Quantity	Units	Unit Price	Total Cost	CO2 Produced (Tons/year)
Tie ingredients					
Cement (type III)	30,000	tons	$ 12.00	$ 360,000	2,509
Coarse Sand	75,000	tons	$ 12.25	$ 918,750	899
Fine Sand	5,000	tons	$ 15.75	$ 78,750	77
Pea Gravel	50,000	tons	$ 14.25	$ 712,500	697
3/4" Gravel	70,000	tons	$ 14.75	$ 1,032,500	1,010
Admixtures					
Retardant	123	gallons	$ 123.00	$ 15,129	22
Air Entrainment	123	gallons	$ 123.00	$ 15,129	22
Water Reducer	123	gallons	$ 123.00	$ 15,129	22
Steel					
Stressing wire	123	tons	$ 123.00	$ 15,129	34
Plastic & PVC					
Date plugs	123	tons	$ 123.00	$ 15,129	8
Form pockets	63,000	each	$ 123.00	$ 7,749,000	3,946
Other items used					
Steel casting forms	123	tons	$ 123.00	$ 15,129	34
Abrasive Cutting Wheels	650	each	$ 123.00	$ 79,950	15
Form release oil	123	gallons	$ 123.00	$ 15,129	2
Circulating oil	123	gallons	$ 123.00	$ 15,129	2
Utilities & Fuel					
Electricity	1,234	kW	$ 123.00	$ 151,782	1,037
Natural gas	1,234	gallons	$ 123.00	$ 151,782	2
Water	1,234	gallons	$ 123.00	$ 151,782	124
Diesel fuel	1,234	gallons	$ 3.95	$ 4,874	14
Biodiesel	1,234	gallons	$ 4.00	$ 4,936	?
Regular gasoline	1,234	gallons	$ 3.50	$ 4,319	14
			Carbon Footprint: (Tons CO2/year)		10,493
			Total Costs: (dollars/year)		$ 11,521,957
Number of ties produced last year:	900,000				
			Emissions per tie: (lbs CO2/tie)		23.317
			Emissions per dollar: (lbs CO2/dollar)		1.82

Recycling Metrics

Item/material recycled	Quantity	Price	Income	Tons CO2 Saved
Rejected ties	500	$ 15.00	$ 7,500	5.83
Scrap concrete (tons)	10	$ 5.00	$ 50	0.05
Scrap stressing wire (tons)	10	$ 5.00	$ 50	0.06
		Total:	$ 7,600	5.93

Landfill Metrics

Tons of Material Landfilled per Year	5,000
Number of Trips to Landfill per Year	500
Gas Mileage of Truck, Full	6
Gas Mileage of Truck, Empty	8
Average Diesel Fuel Price	$ 3.50
Miles to Landfill	25
Landfill Fee ($/ton)	$ 103.00
Gallons of diesel used	146
Transportation Emissions: (Tons CO2/year)	444
Total Cost: (dollars)	$ 515,510

(Spokane Regional Solid Waste)

Inbound Material Transportation

Distance	1,000
Tons of cargo	180
Truck Emissions: (Tons CO2)	16.00
Rail Emissions: (Tons CO2)	5.20

Outbound Tie Transportation

Distance	1,000
Tons of cargo	180
Truck Emissions: (Tons CO2)	16.00
Rail Emissions: (Tons CO2)	5.20

Values entered are for demonstration purposes only, they do not portray CXT's actual results.

Clients:

- As the widest reaching railroad in North America, **CN** is committed to protecting the environment and ensuring the health and safety of their employees and the public.
- As the largest supplier of concrete ties in North America, **CXT** strives to produce a high performance, high value product that is also environmentally responsible.